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MATHEMATICS REQUIREMENTS OF ELECTRONICS RATINGS IN THE JOB ENVIRONMENT

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Fleet personnel in 10 electronics ratings were asked to indicate (1) how often they used skills in 20 mathematics topic areas in performing their jobs, (2) the type of work engaged in when employing mathematics skills, (3) whether mathematics skills ability was helpful to job performance, and (4) whether they required mathematics skills not taught in school in doing their job. Results showed that, except for skills related to basic arithmetic, units, and conversions, the majority of respondents in all ratings surveyed did

not use the skills listed during job perfoarmance. Across all ratings, 27 percent indicated a need for additional mathematics skills; and 67 percent, that mathematical knowledge was helpful during job performance.

FOREWORD

This research and development was conducted under exploratory development task area ZF63.522.011 (Assessment and Enhancement of Prerequisite Skills), work unit 522.011.03.02 (Enhancement of Computational Capabilities), and was sponsored by the Chief of Naval Operations (OP-01). The objectives of the work unit are to identify mathematical skill deficiencies among Navy electronics personnel, to determine the causes of such deficiencies, and to develop instructional strategies to improve the efficiency and job relevance of Navy electronics training.

This report is the fifth in a series designed to identify mathematical requirements relevant to electronics training. Previous reports described the mathematical skills required for successful performance in Navy electronics Class "A" schools, the mathematics skill levels of entering and graduating "A" school students, the mathematics requirements and performance levels in the Navy's Basic Electricity and Electronics school, and the mathematical requirements in the Navy's Class "C" schools, (NPRDC TRs 81-4, 82-2, 82-3, and 82-4). The purpose of the current effort was to identify mathematical skills required in fleet electronics maintenance. Subsequent reports will compare performance with requirements for success, and offer recommendations for curriculum revision. Results of the entire series of reports are intended for use by the Chief of Naval Technical Training.

Appreciation is expressed to the Atlantic Fleet personnel who participated in this study.

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SUMMARY

Problem and Background

The sophistication of military equipment is increasing while training budgets are decreasing. Thus, to assure cost-effective training, those skills and knowledges that are essential for successful job performance in the fleet, as well as the subordinate skills and knowledges that enable the trainee to master essential skills must be identified. Conversely, those skills and knowledges not required for successful performance must be identified and removed from the entrance standards and course objectives. To address this problem, the Center is conducting a project designed to identify mathematical requirements relevant to electronics training. Previous reports issued concerning this project identified the skills required to perform successfully in Navy electronics "A" schools, compared the mathematics skill levels of entering and graduating "A" school students, and identified the skills required to perform successfully in the Navy's Basic Electricity and Electronics schools and in the Navy's "C" schools.

Objective

The objective of this effort was to identify mathematical skills currently required in fleet electronics maintenance.

Approach

Fleet personnel in 10 electronics ratings were asked to indicate how often they used skills in 20 mathematics topic areas in performing their jobs. For skills indicated as being used, respondents were required to describe the type of work they were engaged in when employing that skill. Also, respondents were asked to indicate how helpful general mathematics skills ability was to job performance, and whether they required any mathematics skills not taught in school during job performance.

Findings

1. Except for skills related to basic arithmetic, units, and conversions, the majority of respondents in all ratings surveyed did not use the mathematics skills used during job performance.

2. Of the 20 mathematics topic areas appearing on the mathematics survey, the mean number whose associated skills are used daily on the job by electronics personnel ranged from 1 (GM and AE ratings) to 5 (DS and AV ratings) with a mean of 2.9.

3. Although the frequency with which mathematics skills are used during job performance varies among ratings, the vast majority of respondents in all ratings never use the skills surveyed during job performance.

4. Across all ratings, 27 percent of the respondents indicated a need for additional mathematics skill in performing their jobs; and 67 percent, that mathematics knowledge was helpful during job performance.

Conclusions

The use of mathematics in the daily performance of electronics-related jobs appears to be minimal. However knowledge of mathematics may be considered helpful, as it may enhance one's understanding of electronics theory and thereby facilitate one's ability to

troubleshoot electronic circuitry. Also, previous research indicated that persons may use some skills during task performance without realizing it.

Recommendations

1. Fleet mathematics requirements should be compared with the mathematics currently being taught in the Navy's electronics schools to ensure that all skills required are being taught. NAVPERSRANDCEN is currently conducting this comparison.

2. To explore further fleet mathematical requirements of the electronics ratings, protocol data should be obtained from fleet electronics personnel and analyzed.

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INTRODUCTION

Problem

The sophistication of military equipment is increasing while training budgets are decreasing. Thus, to assure cost-effective training, those skills and knowledges that are essential for successful job performance in the fleet as well as the subordinate skills and knowledges that enable the trainee to master essential skills must be identified. Conversely, those skills and knowledges not required for successful performance must be identified and removed from course objectives.

Background

Navy recruits are assigned to ratings and corresponding Class "A" schools based on scores obtained on the Armed Services Vocational Aptitude Battery (ASVAB), which measures aptitude in a number of areas. Over 23,000 of the approximately 60,000 recruits who enter Navy Class "A" schools every year are trained in electronics maintenance. Before these recruits enter "A" school, however, they must successfully undergo initial training on the fundamentals of electronic theory at one of the Basic Electricity and Electronics (BE/E) preparatory schools. After completing the BE/E and follow-on Class "A" school courses, most students are sent to the fleet. Some then return for more specialized training in electronics equipment at Class "C" schools. There are also a small number of students at the "C" schools who are direct input from the Class "A" schools.

Although preliminary instruction for the electronics schools is more advanced than in most areas of Navy technical training, electronics instructors frequently report that many students are not prepared to begin school curricula. They cite mathematical skills as a primary deficiency among students and view this inadequacy as contributing significantly to unsatisfactory performance in electronics.

To address this problem, the Navy Personnel Research and Development Center is conducting a project designed to identify mathematical requirements relevant to electronics training. The purpose of the first task conducted under this project was to identify the mathematics skills necessary for successful performance in the Navy's electronics "A" schools (Sachar & Baker, 1981). After several electronics textbooks had been reviewed, 70 candidate skills were identified and grouped into 14 topic areas. Next, a survey form that included problems for each of the 70 skills identified was developed and administered to instructors in 14 electronics "A" schools. Respondents were asked to indicate the level of importance of the skill to the course and the level of instruction provided. Survey results were used to develop tests, which were then administered to entering and graduating "A" school students to assess their proficiency in skills rated as affecting performance (Berger, Marr, Cremer, & Berger, 1981). Other reports issued under this project identified the skills needed to perform successfully in Navy Basic Electricity and Electronics schools and in Class "C" schools (Baker, 1981, a and b).

Purpose

The purpose of this effort was to identify those mathematical skills that are required by Navy electronics fleet personnel.

METHOD

Study Participants

Study participants were 712 Atlantic Fleet personnel in 10 ratings. These ratings are representative of the Navy Class "A" and "C" schools included in the previous efforts to identify mathematics skill requirements (Sachar & Baker, 1981; Baker, 1981). Eighty-eight percent of the participants were Class "A" school graduates and 54 percent had graduated from one or more Class "C" schools. Sixty-seven of the AEs and 81 percent of the AVs[1] were shore-based. Over 90 percent of all other ratings represented worked aboard ship. Table 1 lists sample members by pay grade.

Fleet Mathematics Survey Development

A fleet mathematics survey was developed based on the mathematics course requirements survey developed by Sachar and Baker. Although the original survey included questions related to 70 skills grouped under 14 topic areas, the majority of the fleet survey questions were based on topic rather than skill areas, and some of the original 14 topic areas were subdivided to better reflect unique topics. For example, geometry and trigonometry, which appeared on the original survey as one topic area, were separated. The result was the 20 topic areas listed below:

1. Basic arithmetic (addition, subtraction, multiplication, division).
2. Squares and square roots.
3. Exponents.
4. Percentages.
5. Estimation.
6. Fractions.
7. Units.
8. Conversions.
9. Scientific Notation.
10. Decibels.
11. Logarithms.
12. Linear Equations.
13. Quadratic Equations.
14. Algebraic Expressions.
15. Determinants.
16. Geometry.
17. Trigonometry.
18. Polar Coordinates.
19. Number Bases.
20. Boolean Algebra.

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[1]Personnel included under this rating in this study were actually Aviation Electronics, Antisubmarine, or Fire Control Technicians (ATs, AXs, or AQs). Personnel in these ratings attend Navy AV "A" and "C" schools. However, they do not actually enter the AV rating until they reach the E-9 level.

Table 1

Study Participants

Rating	Pay Grade E-2	E-3	E-4	E-5	E-6	Missing Cases	Total
Aviation Electrician's Mate (AE)	1	8	10	16	18	1	54
Avionics Technician[a] (AV)	2	9	32	62	61	1	167
Construction Electrician (CE)	1	0	2	1	0	0	4
Data Systems Technician (DS)	0	0	3	6	4	1	14
Electrician's Mate (EM)	10	34	52	30	20	1	147
Electronics Technician (ET)	0	12	44	37	11	1	105
Electronics Warfare Technician (EW)	0	1	2	5	3	2	13
Fire Control Technician (FT)	0	5	16	26	6	2	55
Gunners Mate (GM)	6	21	30	34	14	2	107
Sonar Technician (ST)	3	6	14	18	5	0	46
Total	23	96	205	235	142	11	712

[a]Personnel included under this rating in this study were actually Aviation Electronics, Antisubmarine, or Fire Control Technicians (ATs, AXs, or AQs). Personnel in these ratings attend Navy AV "A" and "C" schools. However, they do not actually enter the AV rating until they reach the E-9 level.

The survey, which included example problems for each of the 20 topic areas identified, asked respondents to indicate how often (never, daily, weekly, or monthly) they used each skill in the performance of their jobs. For skills indicated as being performed, respondents were asked to describe the type of work they were engaged in when employing the particular mathematics skill. The survey also included questions concerning (1) the benefits of general mathematics skills ability to job performance, and (2) mathematics skills required during job performance that were not taught in school. A copy of the fleet mathematics survey is available upon request from NAVPERSRANDCEN, Code 15.

Administration

The survey was administered at the offices of the Atlantic Tactical Wings, Naval Air Force, Surface Force, and Submarine Force Commanders in Norfolk, Virginia during the last 2 weeks of March 1980. Although the number of participants at any given session varied, administration procedures did not. After providing participants with a copy of the survey, the researcher explained the purpose of the project and gave general instructions. Time to complete the survey varied from 5 to 25 minutes.

RESULTS

Table 2 indicates how often respondents, across all ratings, reported they use each mathematics skill in performing their job. (Responses by rating are provided in the appendix.) As shown, except for skills related to basic arithmetic, units, and conversions (Nos. 1, 7, and 8), the majority of mathematics skills are never used during job performance by the personnel in the ratings surveyed. Of the 20 areas appearing on the survey, the mean number whose associated skills are used daily by electronics personnel ranged from 1 (GM and AE ratings) to 5 (DS and AV ratings) with a mean of 2.9.

Table 3, which presents the mean survey responses by rating, shows that, overall, the majority of respondents never use the mathematics topics listed during job performance. Mean responses in the "Never" column ranged from a low of 57 for the DS rating to a high of 87 for the GM rating.

Table 4 presents the percentages of respondents, by rating, who indicated they had been confronted with a task that required knowledge of mathematics that they were not taught in school. As shown, 27 percent of the overall sample indicated that they were not taught at least one mathematics skill required for the performance of their jobs; the percentages for the individual ratings ranged from a low of 15 for the AE rating to a high of 44 for the FT rating. The specific mathematics topic areas cited by respondents who indicated a job requirement for math skills not taught during training are listed in Table 5. Because of the small number of CE, EW, and DS personnel responding to this question, it is difficult to draw any conclusions concerning their perception of mathematical requirements. At least 50 percent of the AV, EM, FT, GM, and ST respondents who cited a need for additional mathematics skills indicated a requirement for training in at least one additional area. In reviewing Table 1, which indicates how frequently these skills are used during job performance, it appears that some of the skill areas cited are infrequently, if ever, used on the job. Hence, respondents may be indicating only a desire for additional mathematics training, rather than a requirement for job performance.

Table 6, which presents the percentages of respondents indicating that knowledge of mathematics was helpful in performing their jobs, shows that 67 percent of the overall sample felt that mathematics knowledge was helpful, with percentages for individual ratings ranging from 47 for the GM rating to 100 for the CE rating.

Table 2

Survey Responses Across Ratings

	Topic	Frequency				Missing Cases (%)
		Daily (%)	Weekly (%)	Monthly (%)	Never (%)	
1.	Basic Arithmetic	37	29	16	16	2
2.	Squares and Square Roots	3	5	10	80	1
3.	Exponents	8	8	8	73	2
4.	Percentages	11	18	20	50	1
5.	Estimation	15	11	7	65	1
6.	Fractions	12	11	9	65	3
7.	Units	28	14	16	40	2
8.	Conversions	21	16	12	48	3
9.	Scientific Notation	10	7	7	74	2
10.	Decibels	10	8	16	65	2
11.	Logarithms	2	1	3	93	1
12.	Linear Equations	2	2	4	91	1
13.	Quadratic Equations	0	1	2	97	1
14.	Algebraic Expressions	3	4	8	84	2
15.	Determinants	0	0	1	98	1
16.	Geometry	2	3	11	82	2
17.	Trigonometry	1	3	9	85	3
18.	Polar Coordinates	1	1	3	93	2
19.	Number Bases	10	7	8	74	2
20.	Boolean Algebra	11	9	17	61	3
	Total	9	8	9	72	2

Table 3

Mean Survey Responses By Rating

Rating	Frequency				Missing Cases (%)
	Daily (%)	Weekly (%)	Monthly (%)	Never (%)	
AE (N = 54)	9	4	6	78	3
AV (N = 167)	17	10	9	63	1
CE (N = 4)	5	13	18	63	1
DS (N = 14)	18	10	12	57	3
EM (N = 147)	6	6	7	79	2
ET (N = 105)	11	11	15	61	2
EW (N = 13)	10	5	12	69	3
FT (N = 55)	7	12	11	68	2
GM (N = 107)	2	3	6	87	2
ST (N = 46)	8	9	13	68	2

Table 4

Respondents Indicating a Need for Mathematics Skills
Not Taught During Training

Rating	Number of Respondents	Respondents Indicating Need for Skill	
		N	%
AE	48	15	31
AV	155	22	14
CE	3	1	33
DS	14	5	36
EM	120	40	33
ET	94	31	33
EW	13	2	15
FT	55	24	44
GM	100	22	22
ST	41	12	29
Missing Cases	69	--	--
Total	712	174	27

Table 5

Mathematics Topic Areas Cited by Respondents Indicating a Job Requirement for Mathematics Skills Not Taught During Training (N = 174)

Topic	AE (N = 15) (%)	AV (N = 22) (%)	CE (N = 1) (%)	DS (N = 5) (%)	EM (N = 40) (%)	ET (N = 31) (%)	EW (N = 2) (%)	FT (N = 24) (%)	GM (N = 22) (%)	ST (N = 12) (%)
Basic Arithmetic	7	5	0	0	10	6	50	0	18	0
Squares and Square Roots	13	9	0	0	35	10	0	8	9	33
Exponents	7	9	0	0	33	13	0	4	18	25
Percentages	20	0	0	0	23	6	0	0	14	25
Estimation	20	5	0	0	23	10	0	0	18	25
Fractions	13	0	0	0	25	3	0	0	5	17
Units	20	5	0	0	23	10	0	4	23	42
Conversions	27	0	0	0	35	13	0	13	27	42
Scientific Notation	13	5	0	0	33	0	13	23	17	
Decibels	33	32	100	60	50	32	0	54	18	42
Logarithms	20	23	0	0	43	42	0	46	41	17
Linear Equations	7	9	0	0	48	35	0	13	36	17
Quadratic Equations	13	18	0	0	40	32	50	4	36	25
Algebraic Expressions	27	14	0	0	50	23	0	21	32	25
Determinants	20	41	0	0	50	35	0	29	41	25
Geometry	20	23	0	20	48	35	0	4	41	17
Trigonometry	20	18	0	20	55	32	0	8	50	33
Polar Coordinates	20	50	0	0	45	42	0	21	45	33
Number Bases	20	23	100	20	38	29	50	16	41	42
Boolean Algebra	53	18	100	40	48	42	0	18	50	58

Table 6

Respondents Indicating that Knowledge of Mathematics was Helpful in Performing Their Jobs

Rating	Number of Respondents	Respondents Indicating Knowledge Was Helpful N	%
AE	50	29	58
AV	161	109	68
CE	4	4	100
DS	14	12	85
EM	137	89	65
ET	105	88	84
EW	13	8	61
FT	53	38	72
GM	101	47	47
ST	43	30	70
Missing Cases	31	--	--
Total	712	454	67

CONCLUSIONS

The use of mathematics in the daily performance of electronics-related jobs appears to be minimal. However, knowledge of mathematics may be considered helpful, as it may enhance one's understanding of electronics theory and thereby facilitate one's ability to troubleshoot electronic circuitry. Also, previous research (Lave, 1980) has indicated that persons may use some skills during task performance without realizing it. Lave found that, although subjects reported only minimal use of mathematics in performing a basic skills task, analysis of protocols produced by these subjects during task performance uncovered a much greater usage. Thus, it appears that, at times, some skills employed as enablers to the performance of a higher-order task are performed unconsciously. Hence, mathematics may be employed more frequently than indicated by data in this report.

RECOMMENDATIONS

1. Fleet mathematics requirements should be compared with the mathematics currently being taught in the Navy's electronics schools to ensure that all skills required are being taught. NAVPERSRANDCEN is currently conducting this comparison.

2. To further explore fleet mathematical requirements of the electronics ratings, protocol data should be obtained from fleet personnel and analyzed.

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APPENDIX

MATHEMATICS SURVEY RESPONSES BY RATING

AE

Total N = 54		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.26	.44	.15	.07	.07
Squares and Square Roots	2	.80	.02	.02	.13	.04
Exponents	3	.80	.06	.07	.02	.06
Percentages	4	.61	.11	.09	.15	.04
Estimation	5	.65	.20	.07	.06	.02
Fractions	6	.76	.07	.07	.06	.04
Units	7	.54	.28	.15	.04	0
Conversions	8	.61	.20	.09	.06	.04
Scientific Notation	9	.80	.09	.02	.04	.06
Decibels	10	.91	.02	.02	.06	0
Logarithms	11	.95	0	0	.04	.02
Linear Equations	12	.95	0	0	.06	0
Quadratic Equations	13	.98	0	0	.02	0
Algebraic Expressions	14	.78	.06	.02	.11	.04
Determinants	15	.96	0	0	.02	.02
Geometry	16	.93	0	0	.07	0
Trigonometry	17	.89	0	0	.07	.04
Polar Coordinates	18	.93	0	0	.04	.04
Number Bases	19	.82	.04	.09	.04	.02
Boolean Algebra	20	.70	.13	.04	.11	.02
Total		.78	.09	.04	.06	.03

Total N = 167 (AT = 97) (AQ = 66) (AX = 4) Skill	Skill Survey #	Never	Daily	Weekly	Monthly	Missing Cases
Basic Arithmetic	1	.10	.54	.26	.10	0
Squares and Square Roots	2	.75	.07	.08	.08	.01
Exponents	3	.56	.19	.13	.13	.01
Percentages	4	.39	.21	.21	.17	.01
Estimation	5	.60	.22	.13	.05	.01
Fractions	6	.61	.20	.14	.04	.01
Units	7	.35	.37	.19	.08	.01
Conversions	8	.35	.33	.23	.08	.01
Scientific Notation	9	.58	.20	.14	.07	0
Decibels	10	.55	.20	.07	.16	.02
Logarithms	11	.90	.04	.02	.04	.01
Linear Equations	12	.86	.05	.04	.05	.01
Quadratic Equations	13	.96	0	.01	.02	0
Algebraic Expressions	14	.72	.08	.07	.11	.01
Determinants	15	.99	0	0	.01	0
Geometry	16	.80	.02	.06	.11	.01
Trigonometry	17	.80	.03	.05	.10	.02
Polar Coordinates	18	.92	.01	.02	.05	.01
Number Bases	19	.50	.26	.12	.11	.01
Boolean Algebra	20	.40	.30	.14	.16	.01
Total		.63	.17	.10	.09	.01

Total N = 4		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	0	.50	.50	0	0
Squares and Square Roots	2	.75	0	.25	0	0
Exponents	3	.50	0	0	.50	0
Percentages	4	0	.50	.25	.25	0
Estimation	5	.25	0	.75	0	0
Fractions	6	0	0	.50	.25	.25
Units	7	0	0	.25	.75	0
Conversions	8	.25	0	0	.75	0
Scientific Notation	9	1.00	0	0	0	0
Decibels	10	.75	0	0	.25	0
Logarithms	11	1.00	0	0	0	0
Linear Equations	12	1.00	0	0	0	0
Quadratic Equations	13	1.00	0	0	0	0
Algebraic Expressions	14	1.00	0	0	0	0
Determinants	15	1.00	0	0	0	0
Geometry	16	.75	0	0	.25	0
Trigonometry	17	1.00	0	0	0	0
Polar Coordinates	18	1.00	0	0	0	0
Number Bases	19	1.00	0	0	0	0
Boolean Algebra	20	.25	0	.25	.50	0
Total		.63	.05	.13	.18	.01

Total N = 14		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.07	.43	.36	.14	0
Squares and Square Roots	2	.64	.07	.07	.14	.07
Exponents	3	.71	.14	0	.14	0
Percentages	4	.50	.07	.36	.07	0
Estimation	5	.57	.21	.14	.07	0
Fractions	6	.64	.14	.14	.07	0
Units	7	.07	.43	.07	.43	0
Conversions	8	.14	.29	.21	.29	.07
Scientific Notation	9	.64	.14	0	.14	.07
Decibels	10	.57	.14	.07	.21	0
Logarithms	11	.93	0	0	0	.07
Linear Equations	12	.93	0	0	0	.07
Quadratic Equations	13	1.00	0	0	0	0
Algebraic Expressions	14	.71	0	0	.21	.07
Determinants	15	.93	0	0	0	.07
Geometry	16	.64	.14	0	.21	0
Trigonometry	17	.64	.14	.07	.07	.07
Polar Coordinates	18	.86	.07	0	0	.07
Number Bases	19	.07	.57	.21	.14	0
Boolean Algebra	20	.07	.50	.36	.07	0
Total		.57	.18	.10	.12	.03

EM

Total N = 147		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.20	.30	.31	.14	.05
Squares and Square Roots	2	.85	.01	.03	.07	.03
Exponents	3	.87	0	.03	.04	.05
Percentages	4	.54	.08	.18	.18	.01
Estimation	5	.64	.17	.10	.07	.01
Fractions	6	.73	.07	.08	.09	.03
Units	7	.37	.33	.09	.17	.04
Conversions	8	.58	.15	.07	.15	.05
Scientific Notation	9	.89	.02	.03	.03	.02
Decibels	10	.90	0	.03	.04	.02
Logarithms	11	.97	0	0	.03	0
Linear Equations	12	.91	.01	.06	.01	0
Quadratic Equations	13	.97	0	.01	0	0
Algebraic Expressions	14	.90	.03	.05	.02	0
Determinants	15	.99	0	0	0	0
Geometry	16	.88	.01	.01	.05	.04
Trigonometry	17	.89	0	.03	.05	.03
Polar Coordinates	18	.98	0	0	0	.01
Number Bases	19	.98	0	0	0	0
Boolean Algebra	20	.83	0	.03	.11	.02
Total		.79	.06	.06	.07	.02

ET

Total N = 105		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.09	.38	.35	.17	.01
Squares and Square Roots	2	.64	.05	.09	.22	0
Exponents	3	.50	.16	.16	.16	.02
Percentages	4	.42	.12	.17	.29	0
Estimation	5	.53	.21	.14	.09	.02
Fractions	6	.51	.12	.14	.20	.02
Units	7	.26	.39	.18	.15	.02
Conversions	8	.20	.32	.35	.11	.01
Scientific Notation	9	.47	.18	.15	.18	.02
Decibels	10	.31	.15	.19	.31	.03
Logarithms	11	.87	.03	.03	.04	.02
Linear Equations	12	.89	.02	.03	.06	.01
Quadratic Equations	13	.95	.01	0	.04	0
Algebraic Expressions	14	.83	.02	.04	.10	.01
Determinants	15	.97	0	.01	.02	0
Geometry	16	.82	0	.01	.15	.02
Trigonometry	17	.85	.01	0	.12	.02
Polar Coordinates	18	.91	0	.02	.04	.03
Number Bases	19	.69	.05	.09	.15	.03
Boolean Algebra	20	.45	.08	.11	.31	.05
Total		.61	.11	.11	.15	.02

EW

Total N = 13		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.08	.31	.08	.46	.08
Squares and Square Roots	2	.85	0	0	.08	.08
Exponents	3	.69	.08	.15	.08	0
Percentages	4	.69	0	0	.31	0
Estimation	5	.77	.15	.08	0	0
Fractions	6	.69	.15	0	.15	0
Units	7	.31	.23	.23	.23	0
Conversions	8	.38	.23	.15	.15	.08
Scientific Notation	9	.62	.23	.08	0	.08
Decibels	10	.23	.15	.15	.46	0
Logarithms	11	.85	.08	.08	0	0
Linear Equations	12	.85	.15	0	0	0
Quadratic Equations	13	.92	0	0	0	.08
Algebraic Expressions	14	.85	0	.08	.08	0
Determinants	15	.92	0	0	0	.08
Geometry	16	.92	0	0	0	.08
Trigonometry	17	.85	0	0	.15	0
Polar Coordinates	18	.77	.15	0	0	.08
Number Bases	19	.85	.15	0	0	0
Boolean Algebra	20	.77	0	0	.15	.08
Total		.69	.10	.05	.12	.03

Total N = 55		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.13	.31	.38	.18	0
Squares and Square Roots	2	.80	.02	.05	.13	0
Exponents	3	.72	.07	.11	.07	.02
Percentages	4	.44	.04	.33	.18	.02
Estimation	5	.67	.04	.18	.11	0
Fractions	6	.64	.04	.20	.11	.02
Units	7	.33	.29	.22	.13	.04
Conversions	8	.42	.25	.16	.13	.04
Scientific Notation	9	.76	.07	.05	.09	.02
Decibels	10	.51	.05	.16	.20	.07
Logarithms	11	.96	0	.04	0	0
Linear Equations	12	.95	.02	.02	.02	0
Quadratic Equations	13	.98	0	.02	0	0
Algebraic Expressions	14	.91	0	.04	.05	0
Determinants	15	.96	0	0	.04	0
Geometry	16	.73	.04	.09	.14	0
Trigonometry	17	.76	0	.04	.14	.05
Polar Coordinates	18	.89	.04	0	.07	0
Number Bases	19	.58	.09	.11	.18	.04
Boolean Algebra	20	.54	.04	.13	.24	.05
Total		.68	.07	.12	.11	.02

Total N = 107		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.27	.16	.27	.28	.02
Squares and Square Roots	2	.99	0	0	.01	0
Exponents	3	.95	0	.01	.03	.01
Percentages	4	.67	.01	.07	.22	.03
Estimation	5	.84	.06	.02	.06	.03
Fractions	6	.71	.14	.04	.07	.04
Units	7	.65	.02	.11	.22	0
Conversions	8	.89	0	.01	.09	.01
Scientific Notation	9	.96	0	0	.01	.03
Decibels	10	.94	.01	.01	.03	.01
Logarithms	11	.99	0	0	0	.01
Linear Equations	12	.98	0	0	0	.02
Quadratic Equations	13	.98	0	0	0	.02
Algebraic Expressions	14	.95	0	.01	.02	.02
Determinants	15	.97	0	0	.01	.02
Geometry	16	.89	.01	.03	.06	.02
Trigonometry	17	.97	0	0	0	.03
Polar Coordinates	18	.97	0	0	0	.03
Number Bases	19	.97	0	0	0	.03
Boolean Algebra	20	.89	0	.02	.06	.04
Total		.87	.02	.03	.06	.02

Total N = 46		Never	Daily	Weekly	Monthly	Missing Cases
Skill	Skill Survey #					
Basic Arithmetic	1	.15	.43	.33	.09	0
Squares and Square Roots	2	.78	0	.04	.15	.02
Exponents	3	.87	0	.04	.09	0
Percentages	4	.54	.09	.26	.11	0
Estimation	5	.67	.07	.17	.04	.04
Fractions	6	.63	.11	.20	.04	.02
Units	7	.52	.09	.06	.26	.06
Conversions	8	.37	.17	.22	.17	.07
Scientific Notation	9	.85	0	.02	.09	.04
Decibels	10	.28	.20	.15	.35	.02
Logarithms	11	.78	.02	.02	.17	0
Linear Equations	12	.91	0	.02	.06	0
Quadratic Equations	13	.98	0	0	.02	0
Algebraic Expressions	14	.76	.06	.04	.11	.02
Determinants	15	1.00	0	0	0	0
Geometry	16	.61	.11	.02	.24	.02
Trigonometry	17	.70	.07	.02	.20	.02
Polar Coordinates	18	.91	0	0	.04	.04
Number Bases	19	.63	.11	.09	.15	.02
Boolean Algebra	20	.54	.06	.06	.30	.02
Total		.68	.08	.09	.13	.02

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